PATENT SPECIFICATION

756,907

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COMPLETE SPECIFICATION

Improvements in or relating to a Process and Apparatus for the Manufacture of Fibres from Plastic Material

We, ALGEMEENE KUNSTVEZEL MAATSCHAPPIJ NAAMLOOZE VENOOTSCHAP, a Company organised under the Laws of Holland, of 261, Benoordenhoutseweg, The Hague, Holland, do hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a process for the manufacture of fibres from plastic material particularly from glass in the liquid state, of the kind in which the plastic material is caused to flow in the form of streams in a gaseous fluid under pressure, the said streams being drawn into fibres by means of this fluid.

In a process of the above kind which is described in our British Patent No. 665,802 the said streams and the gaseous fluid are caused to pass through an expansion channel having at least one divergent outlet of which the outlet forms the downflow end of the channel, the angle of divergence of the walls relatively to the axis of the channel being less than 1 degree 30 minutes and the ratio of the surface of the outlet and inlet of the divergence being less than 4. For the same ratio values between the absolute pressures upstream and downstream of the expansion channel, fluid speeds can be obtained in the part of the channel corresponding to the minimum section or neck of the divergent outlet greater than those which would be obtained in a channel of uniform section. The attenuating effect exerted by the gaseous fluid on the streams of plastic material is thus improved. The apparatus for putting this process into operation comprises a bushing for the plastic material and an expansion channel for the gaseous fluid under pressure, the entry of the said channel being arranged in the vicinity of the bushing orifices, the said channel having at least one outlet part in divergent form. The channel may be entirely divergent, the cross section being circular or substantially circular or even in the form of an elongated rectangle according to whether the apertures of the bushing of the container holding the plastic material are situated on one or more concentric circles or on one or more parallel rectilinear rows. The channel may also comprise, upstream from the divergence, a convergent portion enabling still higher speeds to be obtained at the neck of the divergent part for one and the same ratio between the absolute pressures of the fluid upstream and downstream of the channel. It is possible, moreover, with the convergent-divergent to obtain the best conditions of operation of the divergent by giving the latter a straight section circular in shape. This shape has in fact been recognised as the most favourable, whatever the arrangement of the apertures of the bushing of the container. If these apertures are arranged in one or more parallel rows, the convergent part is then of a suitable shape to assure a progressive change in the straight section of the channel from a rectangular shape to a true circular shape at the neck of the divergent part.

It has been found that the tractive force exerted by the flow of gaseous fluid on the fibres of plastic material, and which determines the diameter of the fibres obtained from streams of a given diameter, and for a plastic material having determined properties and which is allowed to flow in streams at a determined temperature, depends not only on the maximum speed and conditions of flow of the gaseous liquid in the expansion channel, but also on the conditions of flow of this fluid in the vicinity of the apertures of the bushing and before its entry into the expansion channel. In particular, it has been found

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to be possible, with a given expansion channel and definite conditions of pressure and maximum speed of gaseous fluid, to improve the effect of drawing produced by this gaseous fluid by acting on the conditions of flow of this fluid in the vicinity of the bushing apertures and the entry into the expansion channel.

The process of the present invention is an improvement of the process above described and is characterised by the fact that a turbulance is caused in the flow of the gaseous fluid before the entry of this fluid into the said expansion channel and in the immediate vicinity of the bushing apertures through which the said plastic material flows in the form of streams.

The apparatus for carrying out the process of the invention is distinguished from the apparatus described in our British Patent No. 665,802 by the fact that it comprises, moreover, at least one obstacle arranged in the path of the gaseous fluid to produce, in the vicinity of the said bushing apertures and upstream from the entry into the said channel, a sudden change in the flow of the gaseous fluid. The obstacle or obstacles may consist of one or more elements, e.g. in sheet metal, fixed on at least one of the walls delimiting the passage of the gaseous fluid before its entry into the expansion channel and into the vicinity of the bushing apertures. These obstacles may be arranged on the wall of an enclosure containing the gaseous fluid and/or on the wall of a container holding the plastic material.

In order that the invention may be more readily understood three embodiments of apparatus according to the invention will now be described with reference to the accompanying drawing, in which:—

Fig. 1 is an elevation view in cross section of a first form of apparatus;

Fig. 2 is an elevational view in longitudinal section of Fig. 1;

Fig. 3 is a partial view similar to the view of Fig. 1 of a second form of apparatus;

Fig. 4 is a partial sectional view on the line 4—4 of Fig. 3; and

Fig. 5 is a view similar to that of Fig. 1 of a third form of apparatus.

Each of the forms of apparatus represented comprise a container 1 holding the plastic material, e.g. melted glass 2. This container is entirely housed inside an enclosure 3 in which gaseous fluid under pressure is introduced by apertures 4 and 5. Container 1 consists of a metal crucible fitted at the bottom with bushing apertures 7 through which the plastic material may flow in fine streams. These bushing apertures are arranged in one or more parallel straight rows. A crucible 6 is surrounded by a refractory body 9, the bottom part of which is held on a sheet of metal 10 which serves, together with the bottom of the enclose 3, for delimiting a passage for the flow of gaseous fluid upstream from the place where this current enters into the stop channel.

Container 1 is heated by the passage of an electric current through the walls of the metal crucible 6 which serves as a heating resistance, the ends of this crucible being connected to current leads (not shown). The material to be melted, for example, in the form of cullet or marbles, is introduced into the crucible through a conduit 11 fitted with two baffles 12 and 13 which form a lock. The gaseous fluid under pressure intended for surrounding the streams of molten material and attenuating these streams passes into an expansion channel 15, into which it passes through aperture 14.

In the first form of apparatus shown in Figs. 1 and 2, the expansion channel 15 is slightly divergent and has a straight section in the form of an elongated rectangle which is adapted to the arrangement of the bushing aperture 7 in two rows. In the second form of apparatus, the expansion channel is substantially identical with that of the first form, although the crucible 6 of this form of apparatus has only a single row of bushing apertures 7. Finally, in the straight form of apparatus shown in Fig. 5, the expansion channel comprises a convergent part 16 arranged in the immediate vicinity of bushing apertures 7 of crucible 6 which are arranged in two straight rows, and a divergent part 17 which extends to convergent part 16 and which goes as far as the outlet from the channel. In this last form of apparatus and in order to obtain better conditions of flow of the gaseous fluid in the divergent part 17, the convergent portion 16 has successive cross sections in the desired shape in order to connect its inlet of cross section substantially rectangular with the neck of the expansion channel which is at the entry of divergent portion 17 and which has a cross section circular in form. It has been found, in fact, that a divergence of circular cross section has a better yield for the drawing of the fibres of plastic material. Furthermore, in order to avoid friction of the column of gaseous fluid in the divergent part of the expansion channel, the angle of divergence of this channel, i.e. the angle formed by its walls in relation to its axis, is less than 1 degree 30 minutes, and the ratio between the outlet cross section of the divergent part and the cross section of the neck of the expansion channel is less than 4.

In order to cause a turbulence in the

flow of gaseous fluid before the entry of this fluid into the expansion channel, obstacles 18 are arranged which are fixed to the sheet metal 10 in proximity to the bushing apertures and on either side thereof. Each of these obstacles has a portion 18a which extends through the path of the flow of gaseous fluid and causes a sudden variation in the section and direction of flow of this fluid.

Apart from the obstacles 18, the second form of apparatus comprises a second row of similar obstacles 19 which are also fixed on the metal sheet 10, and the third form of apparatus also comprises obstacles 20 fixed at the bottom of the enclosure 3. The eddies created in the flow of gaseous fluid by obstacles 18, 19 and 20 before the entry of this fluid into the stop channel contribute towards assuring a better attenuation of the streams of plastic material by the flow of gaseous fluid. For example, in the course of experiments of drawing the threads of molten glass, an increase was found of the order of 15-25% of the tractive force exerted by the flow of gaseous fluid according to the speed of the current and the final diameter of the fibres obtained. The obstacles such as those represented at 18, 19 and 20 may extend in a continuous manner the full length of a row of bushing apertures or, on the contrary, may be discontinuous as shown in Fig. 4 in which it can be seen that obstacles 18 each comprise a curved part 18a cut in the form of notches.

What we claim is:—

1. A process for the manufacture of fibres from plastic material, in particular glass in the melted state, comprising the steps of causing the material to flow in the form of streams in a gaseous fluid under pressure, the said streams being drawn into fibres by means of the fluid, causing the said streams and gaseous fluid to pass through an expansion channel having at least one outlet part in the form of a divergent portion of which the outlet forms the down-flow end of the channel, the angle of divergence of the walls relatively to the axis of the channel being less than 1 degree 30 minutes and the ratio of the surface of the outlet and inlet of the divergence being less than 4, and causing a turbulence in the flow of gaseous fluid before the entry of this fluid into the said expansion channel and in the immediate vicinity of bushing apertures through which the plastic material flows.

2. A process as claimed in claim 1, wherein the turbulence is produced by means of obstacles arranged in the path of the flow of gaseous fluid in the vicinity of the bushing apertures and upstream from the inlet to the said expansion channel so as to produce a sudden change in the flow of gaseous fluid.

3. Apparatus for carrying out the process of claim 1, comprising a bushing for the said plastic material and an expansion channel for the said gaseous fluid under pressure, the inlet to this channel being arranged in the vicinity of the bushing apertures and the said channel having at least one outlet part in the form of a divergent portion, and at least one obstacle arranged in the path of the flow of the gaseous fluid, which obstacle causes a sudden change in the flow of gaseous fluid in the vincinity of the said bushing apertures and upstream from the inlet to the said channel.

4. Apparatus according to Claim 3, wherein the said obstacle consists of a piece fixed on the wall of an enclosure containing the gaseous fluid under pressure in the vicinity of the entry of the expansion channel.

5. Apparatus according to Claim 3, wherein the said obstacle is fixed on an envelope of the container holding the plastic material in the vicinity of the said bushing apertures.

6. Apparatus according to any one of the preceding Claims 3 to 5, wherein the said expansion channel is part divergent and part convergent.

7. Apparatus according to any one of the preceding Claims 3 to 7 wherein the expansion channel has a circular cross section, at least in its divergent part.

8. Apparatus according to any one of the preceding Claims 3 to 7, wherein the said expansion channel has a cross section in the form of an elongated rectangle.

9. A process for the manufacture of fibres from plastic material, in particular glass in the melted state, substantially as herein described.

10. Apparatus for the manufacture of fibres from plastic material, in particular glass in the melted state, substantially as herein described with reference to the accompanying drawing.

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756,907 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

FIG. 1.

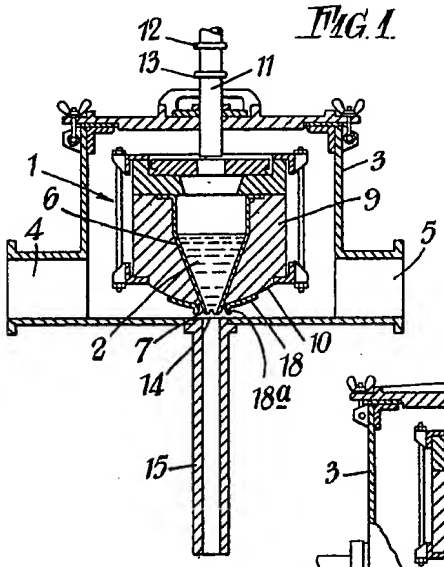


FIG. 2.

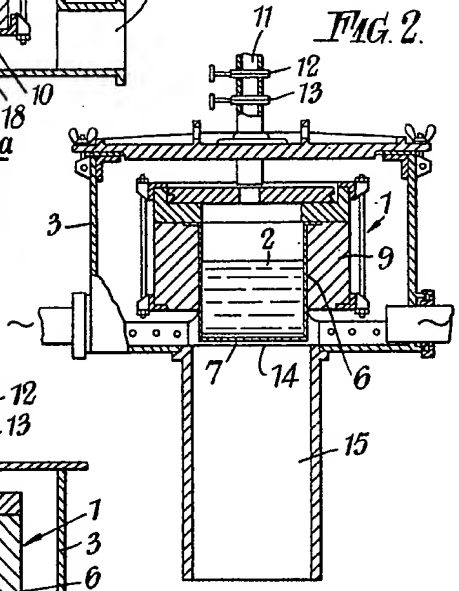
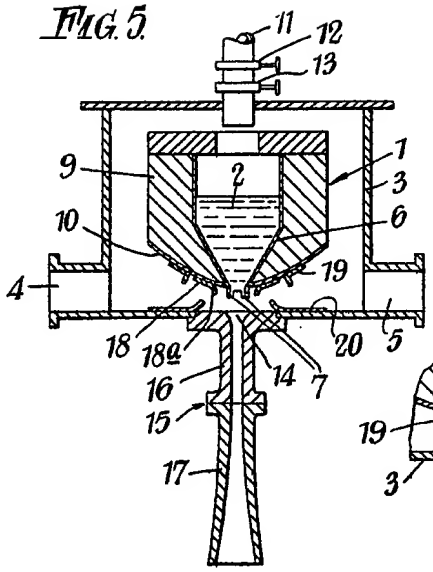


FIG. 5.



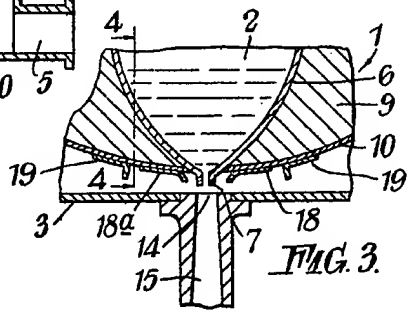


FIG. 3.

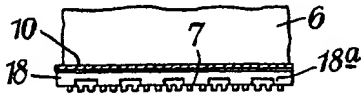


FIG. 4.